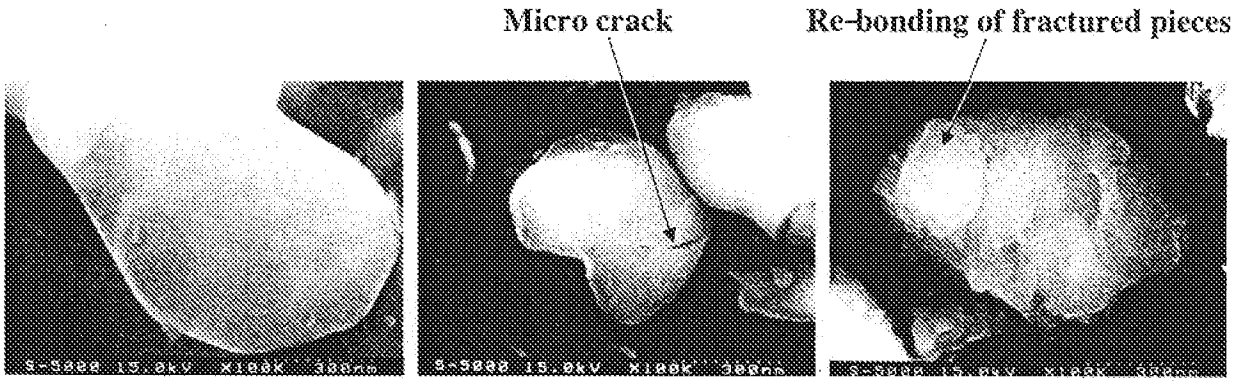
Milling Effects to Ceramic Raw Powders



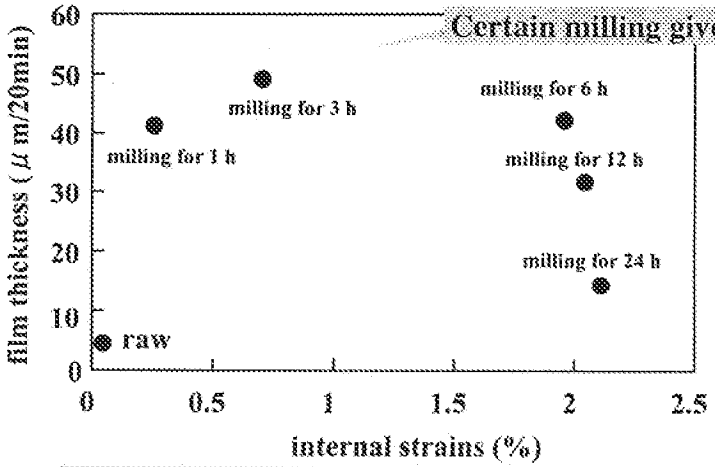
	Raw particle	Dry milling for 3 h	Dry milling for 24 h
Crystallite size:	740 Å	345 Å	286 Å
Internal strain:	0.04%	0.65%	2.1%

Crush by the dry planetary mill fractures Al_2O_3 particles randomly.

We take advantage of these morphological changes.

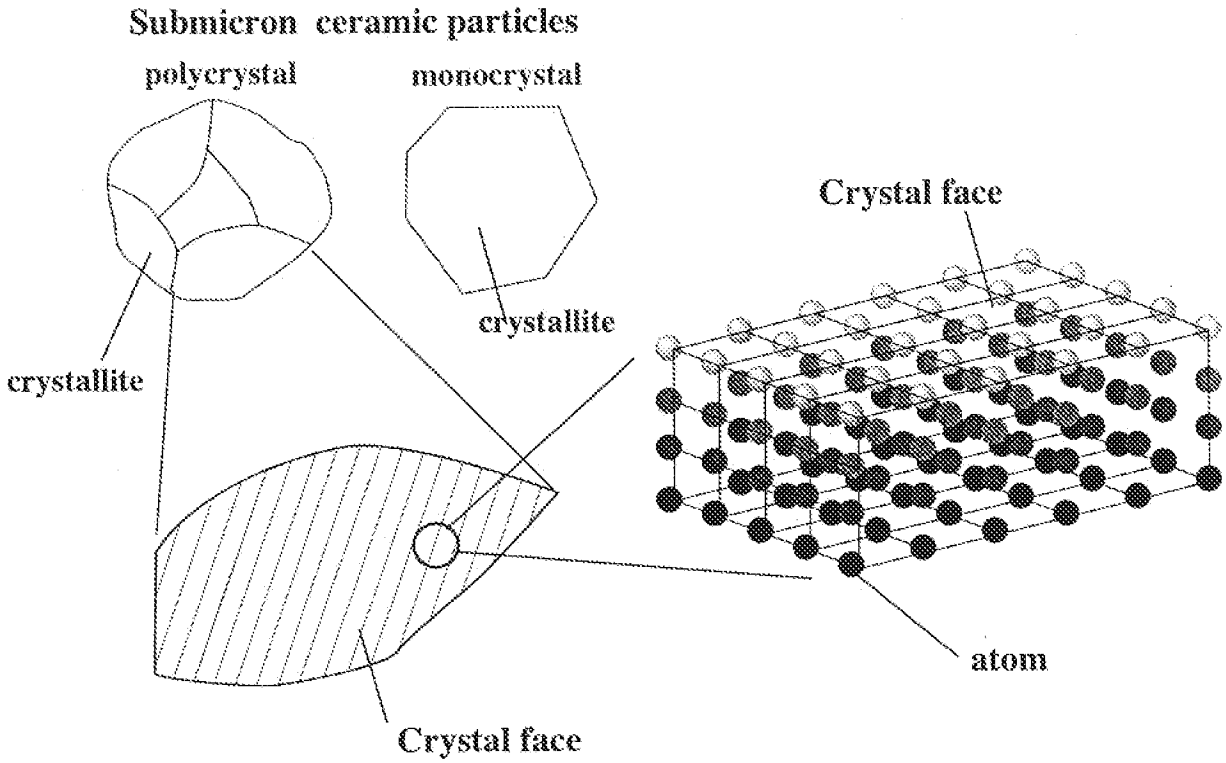
Milling Effects for Deposition

Dry milling was carried out to give internal strains to powders
After that, deposition was carried out.



Powder: Al_2O_3
milling method: dry planetary mill
estimation of internal strains:
Using Hall method
Raw powder aged at 1000 degrees C for the zero standard

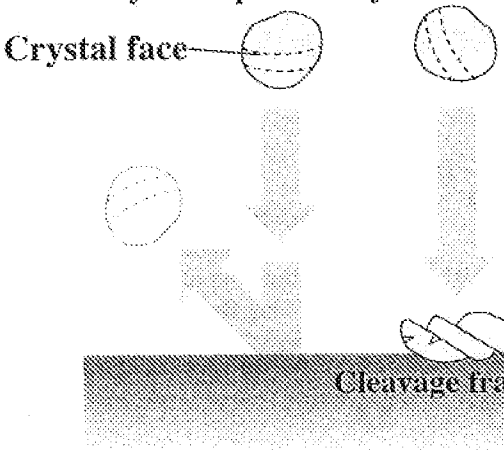
Milling is very effective as pre-treatment of powders.



Current technique

Structuring depends on
the suitable particle velocity and
the suitable collision angle toward crystal face .

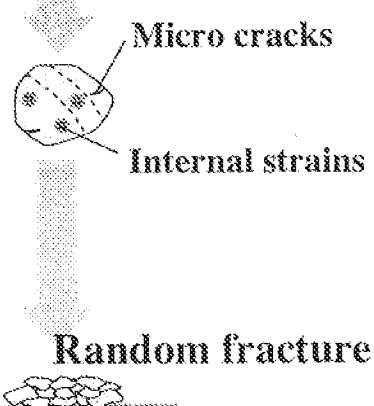
Self-selectivity for deposition by collision angle



Therefore deposition efficiency is very low.

Our patent

Pretreatment of raw powder



We achieved wide area deposition with high depo-rate.

Current Methods

Collision angle provides self-selectivity
which particles to be deposited in what rate

- The resulted film has a tendency in its crystal structure.
- Low deposition efficiency

New Technology

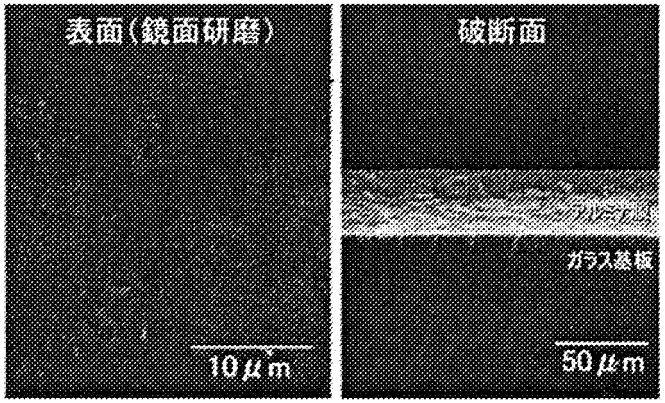
random fractures upon AD process
⇒ Collision angle provides less self-selectivity.

- Crystal orientation of AD film quantified by integral intensity raito of specific peaks in XRD profile is very poor and is in good agreement with particles (The deviation is less than 30%).
- More particles are deposited in good rate (High deposition Efficiency)

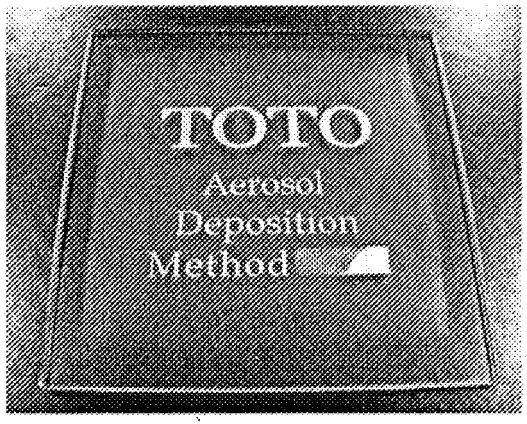
In the patent, as one technique, internal strains of the particles caused by milling (pretreatment) enables the random fractures.

TOTO

Features of Aerosol Deposition (AD)



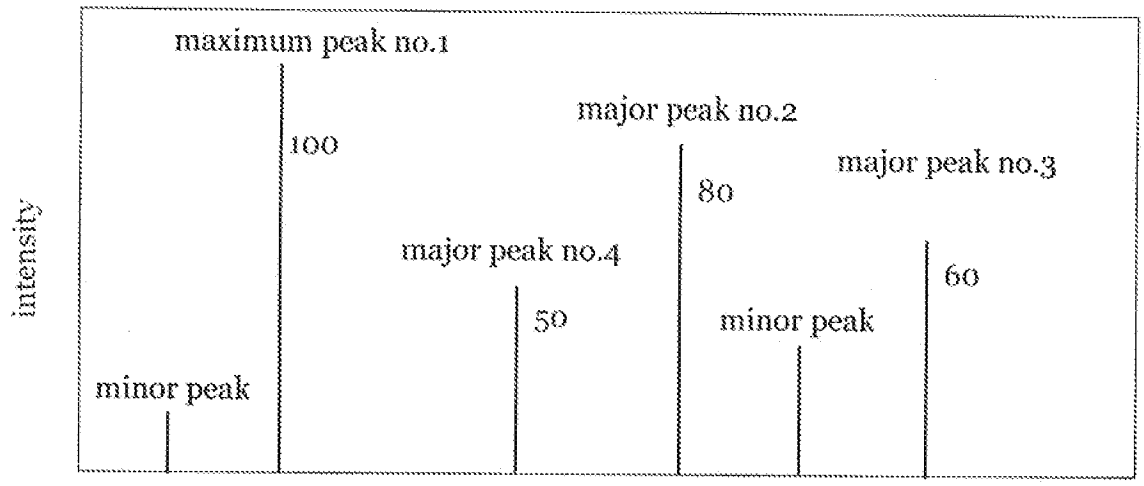
Surface Fracture cross section



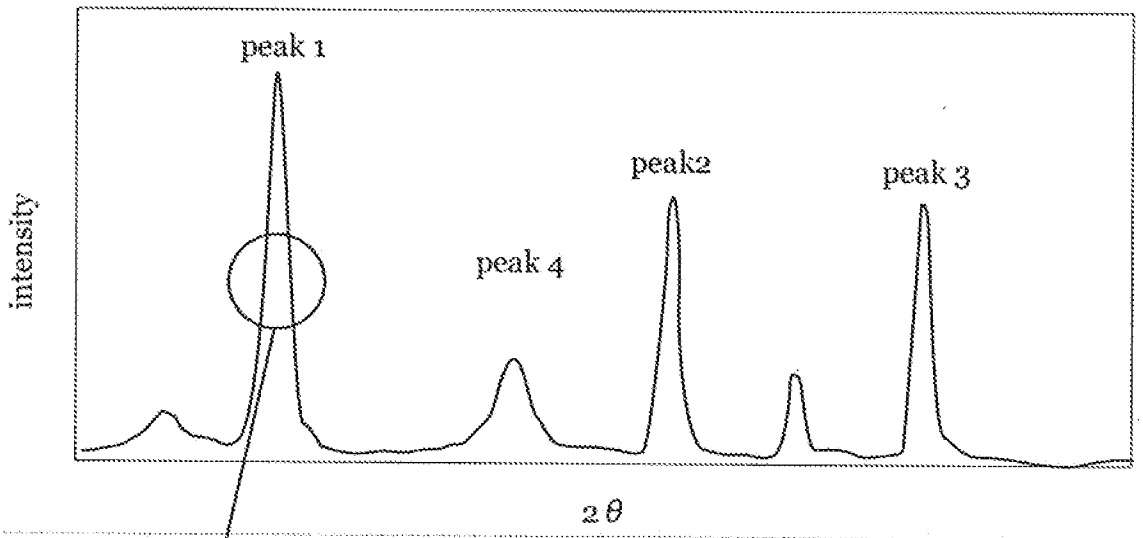
Appearance

- AD is the technique to fabricate thick (1 to several tens μm) ceramic films
- Room temperature process
- Films are composed of nano-crystal dense structure
- Good performance in adhesion, hardness, translucency

JCPDS card



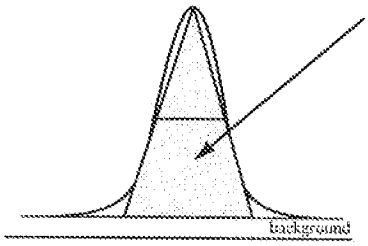
XRD chart of AD structure



integrated intensity estimation by triangle approximation method

integrated intensity = (peak height) * (harf width)

planimetry of this area xxx mm²



	peak 1	peak2	peak3	peak4
peak intensity from JCPDS	100	80	60	50
integrated intensity from XRD	20 mm²	16.4 mm²	10.6 mm²	4.4 mm²
revised value	100	82	53	22
deviance of oriantation	—	2%	12%	56%

no orientation < 30%

(1-82/80)*100 %

EXHIBIT C